CLAIMS

What is claimed is:

1. A method for producing a Group 8 (VIII) metallocene compound, comprising the steps of:

a) reacting a metal salt (MX_n) compound, a Cp compound and a ligand (L) to form an intermediate compound; and

b) reacting the intermediate compound with a Cp' compound to produce the metallocene compound, wherein,

M is selected from the group consisting of Ru, Os and Fe;
L is an electron pair donor;
Cp and Cp' are η^n-coordinated moieties that and are both unsubstituted or either or both of Cp and Cp' includes at least one substituent that is selected form the group consisting of:
X;
$C_{a1}H_{b1}X_{c1}$;
$C_{a2}H_{b2}X_{c2}(C{=}O)C_{a1}H_{b1}X_{c1}$;
$C_{a2}H_{b2}X_{c2}OC_{a1}H_{b1}X_{c1}$;
$C_{a2}H_{b2}X_{c2}(C{=}O)OC_{a1}H_{b1}X_{c1}$; and
$C_{a2}H_{b2}X_{c2}O(C{=}O)C_{a1}H_{b1}X_{c1}$;

where

X is F, Cl, Br, I or NO_2;
a1 is an integer from 1 to 8;
b1 is an integer from 0 to 2(a1)+1 – c1;
c1 is an integer from 0 to 2(a1)+1 – b1;
b1 + c1 is at least 1;
a2 is an integer from 0 to 8;
b2 is an integer from 0 to 2(a2) + 1 – c2;
c2 is an integer from 0 to 2(a2) + 1 – b2.

2. The method of Claim 1, further including the step of isolating the intermediate compound.

3. The method of Claim 1, wherein the Cp compound is a substituted or unsubstituted cyclopentadiene .

4. The method of Claim 1, wherein Cp' is an anion of a substituted or unsubstituted cyclopentadiene compound.

5. The method of Claim 1, wherein the Cp' compound is a cyclopentadienide salt.

6. The method of Claim 1, wherein Cp' is the same as Cp.

7. The method of Claim 1, wherein Cp is different from Cp'.

8. The method of Claim 1, wherein MX_n is an anhydrous or a hydrated metal halide or metal nitrate.

9. The method of Claim 1, wherein L is a phosphine or a phosphine triester.

10. The method of Claim 1, wherein at least one of MX_n, L, Cp or Cp' is present in a solvent.

11. The method of Claim 1, wherein MX_n, L and Cp are reacted in a solvent medium.

12. The method of Claim 11, wherein MX_n, L and Cp are reacted at the boiling temperature of the reaction mixture.

13. The method of Claim 1, wherein the intermediate compound and Cp' are reacted is a second solvent medium.

14. The method of Claim 13, wherein the intermediate compound and Cp' are reacted at the boiling temperature of the reaction mixture.

15. The method of Claim 1, wherein the intermediate compound is not isolated prior to being reacted with the Cp' compound.

16. The method of Claim 1, wherein, either or both of Cp or Cp' includes at least one additional substituent selected from the group consisting of:

X
$C_{a1}H_{b1}X_{c1}$,
$C_{a2}H_{b2}X_{c2}(C{=}O)C_{a1}H_{b1}X_{c1}$,
$C_{a2}H_{b2}X_{c2}OC_{a1}H_{b1}X_{c1}$,
$C_{a2}H_{b2}X_{c2}(C{=}O)OC_{a1}H_{b1}X_{c1}$, or
$C_{a2}H_{b2}X_{c2}O(C{=}O)C_{a1}H_{b1}X_{c1}$

where,

X is F, Cl, Br, I or NO_2;
a1 is an integer from 0 to 8
b1 is an integer from 0 to 2(a1)+1 – c1
c1 is an integer from 0 to 2(a1)+1 – b1
b1 + c1 is equal to or greater than 1
a2 is an integer from 0 to 8
b2 is an integer from 0 to 2(a2)+1 – c2
c2 is an integer from 0 to 2(a2)+1 – b2
b2 + c2 is equal to or greater than 1.

17. A method for producing a Group 8 (VIII) symmetrical metallocene compound, comprising the steps of reacting $MX_2(PPh_3)_m$ with a Cp' compound, wherein M

is Ru, Os or Fe, m = 3 or 4, X is F, Cl, Br or I, Cp’ is a cyclopendadienyl anion and the Cp’ compound is a cyclopentadienide salt.

18. The method of Claim 17, further comprising the step of forming the $MX_2(PPh_3)_m$ by reacting a metal salt (MX_n) with triphenylphosphine.

19. The method of Claim 18, wherein MX_n is an anhydrous or a hydrated metal halide or a metal nitrate.